REMARKS

Favorable reconsideration of this application in view of the foregoing amendments and remarks to follow is respectfully requested. Since the present amendments raise no new issues, and in any event, place the application in better condition for consideration on appeal, entry thereof is respectfully requested.

Before addressing the specific grounds of rejection raised in the present Office Action, applicants have amended the claims in the manner indicated supra. Specifically, applicants have canceled Claim 1, without prejudice or disclaimer; amended Claims 2-6, 8, 12, 13, 15, 22-30, 32, 34, 37 and 38; and have added new independent Claim 45.

The newly added claim is directed to a method of fabricating a bipolar device which includes the steps of: (a) providing a structure comprising at least a sub-collector region, a collector region and isolation regions, said collector region including a deep collector region located therein; (b) forming a n-type dopant region within said collector region so as to be in contact with said deep collector, said n-type dopant region having a vertical width sufficiently narrow to avoid lowering collector-base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when a base-emitter junction is forwarded biased; (c) forming a base; and (d) forming an emitter.

Support for newly added Claim 45 is found in original Claim 1, the text appearing at Page 9, line 20-Page 14, line 21, and FIGS 2A-2D. Applicants note that in step (b) of new Claim 45 the term "n-type dopant region" replaces the term "diffusion" found in original Claim 1. Support for this term is found at Page 11, lines 6-21 of the specification of the instant application.

The cancellation of original Claim 1, and the inclusion of new method Claim 45, necessitated the amendments made to dependent Claims 2-6, 8, 12, 22 and 23. In most instances, the foregoing claims were amended by either changing their dependency from canceled Claim 1 to new Claim 45 and/or by replacing the term "diffusion" with "n-type dopant region".

The other independent claim present in the instant application, i.e., Claim 24, was amended to positively recite the presence of a deep collector and a n-type dopant region in the collector region; note the term 'diffusion" was again replaced with the term "n-type dopant region". Support for this amendment to Claim 24 is found at Page 10, line 19-Page 11, line 13.

In each of dependent Claims 25-30, 32, 34, 37 and 38, the term "diffusion" was replaced with the term "n-type dopant region".

Since the above amendments to the claims are fully supported by the specification of the present application, entry thereof is respectfully requested. Applicants submit that the above amendments to the claims do not raise any new issues that would require any additional searching and/or consideration by the Examiner. Rather, the above amendments to the claims clearly define applicants' claimed method and bipolar device obtained therefrom which are fully disclosed in the specification as well as depicted in the drawings of the present application.

Pursuant to 37 C.F.R. §1.121, applicants have attached hereto a marked-up copy of the amended claims showing the changes made by the current amendments. The attachment is captioned as **"MARKED-UP VERSION SHOWING CHANGES MADE".**

Claims 1-19 and 21-43 stand rejected under 35 U.S.C. §103 as allegedly unpatentable over the combined disclosures of U.S. Patent No. 5,620,907 to Jalali-Farahani, et al. ("Jalali-Farahani, et al.") and excerpts from Streetman's book entitled "Solid State Electronic Devices" ("Streetman"). Claims 20 and 44 stand rejected under 35 U.S.C. §103 as allegedly unpatentable over Jalali-Farahani, et al. and U.S. Patent No. 6,087,683 to King, et al. ("King, et al.").

In regard to method Claims 1-23, applicants respectfully submit that the method claims of the present application are not obvious from the combined disclosures of Jalali-Farahani, et al. and Streetman or Jalahi-Farahani, et al. and King, et al. since none of the applied references teaches or suggests a method of fabricating a bipolar device which includes a step of *forming a n-type dopant region within a collector region containing a deep collector so as to be in contact with said deep collector, said n-type dopant region having a vertical width sufficiently narrow to avoid lowering collector-base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when a base-emitter junction is forwarded biased.*

Applicants respectfully submit that the n-type dopant region of the claimed invention improves the AC performance of the SiGe heterojunction bipolar transistor as well as the speed and ruggedness of the transistor.

Jalali-Farahani, et al. provide a method for making a silicon heterojunction bipolar transistor which includes the steps of (a) forming a substantially single-crystalline Si collector region of a first conductivity type within a window defined in a layer of dielectric material; (b) forming, over the collector region and over at least a portion of the dielectric layer adjacent to the collector region, a Si nucleation layer and then a SiGe alloy layer of a second

conductivity type opposite to the first conductivity type such that each resulting layer has a part to be referred to as intrinsic that overlies the collector region and a part to be referred to as extrinsic that overlies the dielectric layer, and such that each resulting layer is substantially epitaxial in the intrinsic part thereof and substantially polycrystalline in the extrinsic part thereof; (c) forming, over the alloy layer, a Si emitter layer of the first conductivity type such that the resulting emitter layer comprises a substantially epitaxial part that overlies the collector region and a substantially polycrystalline part that overlies the dielectric layer; and (d) implanting doping species of the second conductivity type into the extrinsic parts of at least the SiGe alloy layer and the emitter layer while substantially excluding the dopant species from the intrinsic parts of the alloy layer and the emitter layer. In accordance with the disclosure of Jalali-Farahani, et al., the implanting step leads to a doping level of the second conductivity type in both the extrinsic part of the alloy layer and the extrinsic part of the emitter layer.

Applicants respectfully submit that the disclosure of Jalali-Farahani, et al. does not teach or suggest forming *a n-type dopant region within the collector region, let alone forming a n-type dopant region within said collector region so as to be in contact with said deep collector, said n-type dopant region having a vertical width sufficiently narrow to avoid lowering collector-base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when a base-emitter junction is forwarded biased.* These limitations on the n-typed dopant region, which are essential to the claimed method, are not taught or suggested by Jalali-Farahani, et al.

Streetman does not alleviate the above defects in Jalali-Farahani, et al. since the applied secondary reference also does not teach or suggest forming *a n-type dopant region*

within the collector region, let alone forming a n-type dopant region within said collector region so as to be in contact with said deep collector, said n-type dopant region having a vertical width sufficiently narrow to avoid lowering collector-base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when a base-emitter junction is forwarded biased. Instead, Streetman discloses that it is common-place to use a thermal process such as RTA to diffuse dopant species from a region of high concentration to another region within a substrate of an IC structure. Streetman provides no guidance whatsoever for forming *a n-type dopant region within the collector region, let alone forming a n-type dopant region within said collector region so as to be in contact with said deep collector, said n-type dopant region having a vertical width sufficiently narrow to avoid lowering collector-base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when a base-emitter junction is forwarded biased.* As such, the combined disclosures of Jalali-Farahani, et al. and Streetman do not render applicants' claimed method obvious since none of those applied references teaches or suggests forming applicants' claimed diffusion region.

King, et al. also do not alleviate the above-mentioned defects in Jalali-Farahani, et al. since the applied secondary reference does not teach or suggest forming *a n-type dopant region within the collector region, let alone forming a n-type dopant region within said collector region so as to be in contact with said deep collector, said n-type dopant region having a vertical width sufficiently narrow to avoid lowering collector-base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when a base-emitter junction is forwarded biased.* King, et al. provide a method for forming a bipolar heterostructure which includes the steps of: forming a n-type doped collector region in a

semiconductor substrate; forming a SiGe base on the collector; epitaxially doping the base with In while forming the base to achieve a natural concentration of In in the base; and forming an emitter on the base. Applicants respectfully submit that King, et al. do not teach or suggest forming a n-type dopant region in the collector which has the limitations recited in the claims of the present application. As such, the combined disclosures of Jalali-Farahani, et al. and King, et al. does not render applicants' claimed method obvious.

In view of the above remarks, the combined disclosures of Jalali-Farahani, et al. and Streetman or Jalali-Farahani, et al. and King, et al. do not render applicants' method claims obvious since none of the applied references teaches or suggests forming applicants' claimed n-type dopant region.

Insofar as Claims 24-44 are concerned, applicants submit that the claimed bipolar transistor is not rendered obvious from the combined disclosures of Jalali-Farahani, et al. and Streetman or Jalali-Farahani, et al. and King, et al. since none of the applied references teaches or suggests a bipolar transistor which comprises *a subcollector, a deep collector and a n-type dopant region between said sub-collector and said base-collector junction, said n-type dopant region is located atop said deep collector and has a vertical width sufficiently narrow to avoid lowering collector-base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when the base-junction is forward biased.*

Jalali-Farahani, et al. provide a heterojunction bipolar transistor which has intrinsic and extrinsic base portions. The intrinsic base portion substantially comprises epitaxial SiGe, while the extrinsic base portion substantially comprises polycrystalline material, which contains a distribution of ion-implanted impurities. An emitter overlies the intrinsic base portion, and a spacer at least partially overlies the emitter. The spacer overhangs the extrinsic

base portion by at least a distance characteristic of lateral straggle of the ion implanted species.

Applicants respectfully submit that Jalali-Farahani, et al. do not teach or suggest a bipolar transistor which comprises *a subcollector, a deep collector and a n-type dopant region between said sub-collector and said base-collector junction, said n-type dopant region is located atop said deep collector and has a vertical width sufficiently narrow to avoid lowering collector-base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when the base-junction is forward biased.*

Streetman discloses IC structures in which thermal heating is used to form a diffusion region in the semiconductor substrate. Applicants respectfully submit that Streetman is not related to bipolar transistor devices, let alone a bipolar transistor device having the claimed n-type dopant region which is in contact with a deep collector region, wherein the n-type dopant region *has a vertical width sufficiently narrow to avoid lowering collector-base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when the base-emitter junction is forward baised.* As such, the combined disclosures of Jalali-Farahani, et al. and Streetman do not render applicants' claimed bipolar transistor.

Insofar as the combination of Jalali-Farahani, et al. and King, et al. is concerned, applicants respectfully submit that King, et al. do not alleviate the above-mentioned defects in Jalali-Farahani, et al. since the applied secondary reference also fails to teach or suggest a bipolar transistor which includes applicants' claimed n-type dopant region present in the collector region of the device. As such, the combined disclosures of Jalali-Farahani, et al. and King, et al. do not render applicants' claimed structure obvious.

The §103 rejections also fail because there is no motivation in the applied references which suggests modifying the disclosed methods and structures to include the various features, particularly the claimed n-type dopant region which is in contact with a deep collector and has a vertical width sufficiently narrow to avoid lowering collector-base breakdown voltage and a doping sufficiently high to restrict base widening when the base-emitter junction is forward baised. Thus, there is no motivation provided in the applied references, or otherwise of record, to make the modification mentioned above. "The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification." In re Vaeck, 947 F.2d, 488, 493, 20 USPQ 2d. 1438, 1442 (Fed.Cir. 1991).

The rejections under 35 U.S.C. §103 have been obviated; therefore reconsideration and withdrawal thereof are respectfully requested.

Thus, in view of the foregoing amendments and remarks, it is firmly believed that the present case is in condition for allowance, which action is earnestly solicited.

Respectfully submitted,

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ATTACHMENT: MARKED-UP VERSION SHOWING CHANGES MADE

IN THE CLAIMS:

Please cancel Claim 1, without prejudice or disclaimer, and please amend Claims 2-6, 8, 12, 13, 15, 22-30, 32, 34, 37 and 38 to read as follows:

2. (Amended) The method of Claim [1] 45 wherein in said providing step (b) said vertical width of said [diffusion] n-type dopant region is less than about 2000 Å.

3. (Amended) The method of Claim 2 wherein in said providing step (b) said vertical width of said [diffusion] n-type dopant region is from about 800 to about 1200 Å.

4. (Amended) The method of Claim [1] 45 wherein in said providing step (b) said [diffusion] n-type dopant region has a peak doping concentration and said collector has a peak doping concentration, wherein said peak doping concentration of said [diffusion] n-type dopant region is greater than said peak doping concentration of said collector.

5. (Amended) The method of Claim [1] 45 wherein in said providing step (c) said base has a peak doping concentration and wherein said [diffusion] n-type dopant region has a peak doping concentration that is lower than said peak doping concentration of said base.

6. (Amended) The method of Claim [1] 45 wherein in said providing step (b) said [diffusion] n-type dopant region comprises a dopant selected from the group consisting of As, Sb and P.

8. (Amended) The method of Claim 6 wherein in said providing step (b) said [diffusion] n-type dopant region is formed by ion implantation and activation annealing.

12. (Amended) The method of Claim [1] 45 wherein in said forming step (c) said [diffusion] n-type dopant region is located adjacent the base-collector junction.

13. (Amended) The method of Claim [1] 45 wherein in said forming step (c) further comprises providing a lightly doped collector separating said [diffusion] n-type dopant region from said base.

15. (Amended) The method of Claim [1] 45 wherein said forming step (c) comprises forming a heterojunction.

22. (Amended) The method of Claim [21] 45 wherein said [collector includes a] deep collector [that] is formed by ion implantation and annealing.

23. (Amended) The method of Claim [1] 45 wherein in said providing step (a) said sub-collector is formed by ion implantation into a substrate or by epitaxially growing said sub-collector on a substrate.

24. (Amended) A bipolar transistor comprising:

an emitter, a base, a collector, a base-emitter junction, and a base-collector junction, wherein said collector comprises a subcollector, a deep collector and [diffusion] a n-type dopant region between said sub-collector and said base-collector junction, [wherein] said [diffusion] n-type dopant region is located atop and in contact with said deep collector and has a vertical width sufficiently narrow to avoid lowering collector-base breakdown voltage and a [doping] dopant concentration sufficiently high to restrict base widening when the base-junction is forward biased.

25. (Amended) The bipolar transistor of Claim 24 wherein said [diffusion] n-type dopant region is located adjacent the base-collector junction.

26. (Amended) The bipolar transistor of Claim 24 wherein said vertical width of said [diffusion] n-type dopant region is less than about 2000 Å.

27. (Amended) The bipolar transistor of Claim 26 wherein said vertical width of said [diffusion] <u>n-type dopant region</u> is from about 800 to about 1200 Å.

28. (Amended) The bipolar transistor of Claim 24 wherein said [diffusion] <u>n-type dopant region</u> has a peak doping concentration and said collector has a peak doping concentration, wherein said peak doping concentration of said [diffusion] <u>n-type dopant region</u> is greater than said peak doping concentration of said collector.

29. (Amended) The bipolar transistor of Claim 24 wherein said base has a peak doping concentration and wherein said [diffusion] <u>n-type dopant region</u> has a peak doping concentration that is lower than said peak doping concentration of said base.

30. (Amended) The bipolar transistor of Claim 24 wherein said [diffusion] <u>n-type dopant region</u> comprises a dopant selected from the group consisting of As, Sb and P.

32. (Amended) The bipolar transistor of Claim 24 further comprising a lightly doped collector separating said [diffusion] <u>n-type dopant region</u> from said base.

34. (Amended) The bipolar transistor of Claim 24 wherein said [diffusion] <u>n-type dopant region</u> provides a higher speed of the transistor by restricting base widening.

37. (Amended) The bipolar transistor of Claim 24 wherein said [diffusion] <u>n-type dopant region</u> has a dopant concentration of from about 5E16 to about 5E17 cm^{-3}.

38. (Amended) The bipolar transistor of Claim 24 wherein said [diffusion] <u>n-type dopant region</u> has a dopant concentration of from about 8E16 to about 2E17 cm^{-3}.

<u>Please add the following new claim</u>:

--45. A method of fabricating a bipolar device comprising the steps of:

(a) providing a structure comprising at least a sub-collector region, a collector region and isolation regions, said collector region including a deep collector region located therein;

(b) forming a n-type dopant region within said collector region so as to be in contact with said deep collector, said n-type dopant region having a vertical width sufficiently narrow to avoid lowering collector-base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when a base-emitter junction is forwarded biased;

(c) forming a base; and

(d) forming an emitter.--